Optimization of nutrient fluxes in European agriculture by using bio-based mineral fertilizer substitutes: a field experiment

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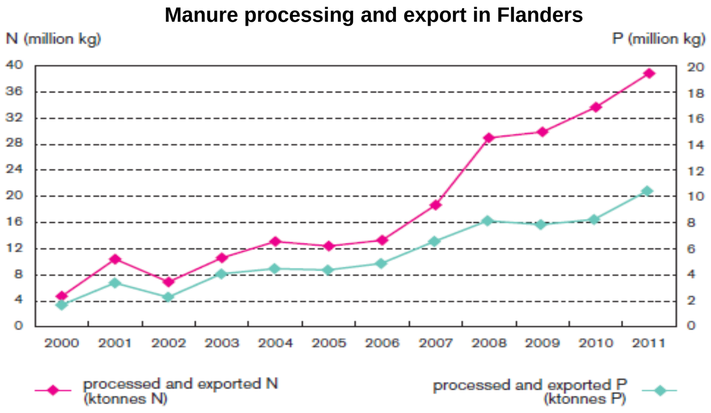
INTRODUCTION

- Several regions in Europe such as Flanders (Belgium) are confronted with manure surplus as a consequence of intensive livestock production. These regions are obliged to process and export the manure surplus.

Manure processing and export in Flanders



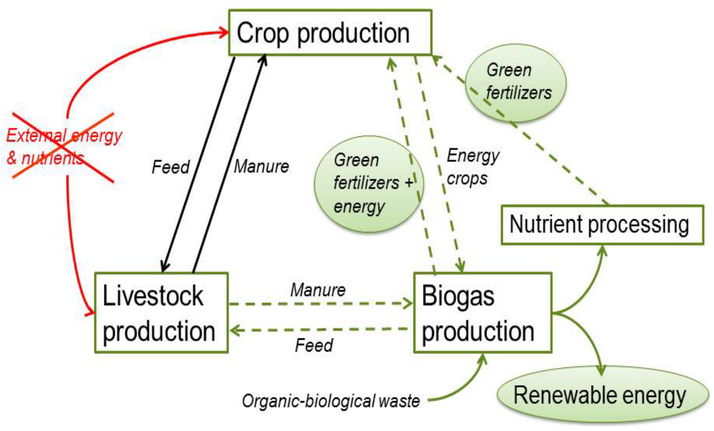
Source: MIRA (2013)

- In contrast, European agriculture is faced with an increasing demand for synthetic fertilizers. The solution for the existing paradox can be found in a sustainable resource management which is in line with the cradle-to-cradle approach: waste should be turned into secondary resources.

- With the goal to use bio-digestion derivatives as a substitute for mineral fertilizers, several field trials were conducted within the projects *INTERREG IV - ARBOR (Accelerating Renewable Energies through Valorization of Biogenic Organic Raw Material) and MIP – NutriCycle (Green fertilizer from digestate and manure).*

- A first field trial was conducted in Wingene. No statistical differences could be identified when comparing classic fertilisation versus green fertilizers with respect to crop yield, soil fertility and quality.

- In order to validate the results and evaluate the impact on soil quality in the longer term, these field trials were continued in the following years (2012 – 2013).



"CRADLE – TO – CRADLE"

EXPERIMENTAL SETUP 2013

- In 2013, field trials were conducted on two different locations in Belgium: Wingene (sandy soil) and Roeselare (sandy-loam soil).

Field trial 2013	Field 1	Field 2
Location	Wingene, BE	Roeselare, BE
Number of scenarios	1 - 8	1 – 11
Soil type	Sandy soil	Sandy – loam soil
Test plant	Energy maize	Energy maize

- In total, on both fields, eleven different fertilization treatments (n=4) were applied.
- Conventional fertilization regime (manure + artificial fertilizers) served as a reference = Scenario 1.

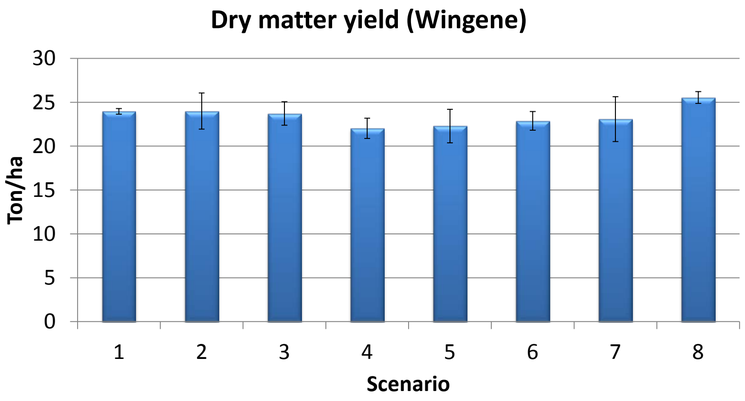
Scenario	Artificial start fertilizer E	Animal manure ton	Artificial fertilizer E	Air scrubber water liter	Mixture digestate/LF digestate ton	Digestate ton	LF digestate ton	LF of animal manure ton	Ureum liter
1	x	x	x	-	-	-	-	-	-
2	x	x	-	x	-	-	-	-	-
3	-	x	-	x	-	-	-	-	-
4	x	-	-	-	x	-	-	-	-
5	x	-	x	-	-	x	-	-	-
6	-	-	-	x	-	x	-	-	-
7	x	x	-	-	-	-	x	-	-
8	-	x	-	x	-	-	x	-	-
9	-	x	-	-	-	-	-	-	x
10	x	x	-	-	-	-	-	x	-
11	-	x	-	x	-	-	-	x	-

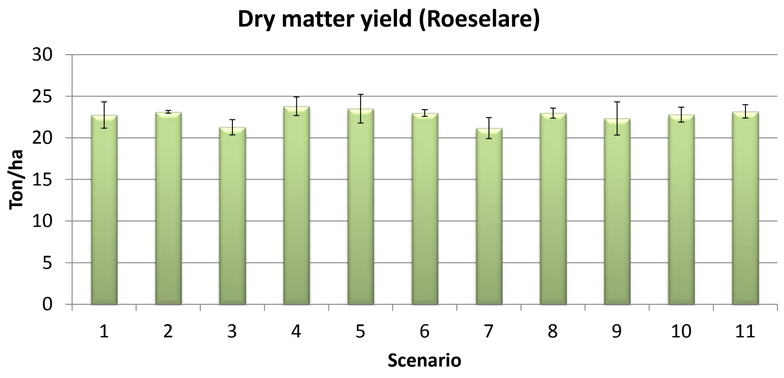
- Soil sampling: July, September, October (harvest), November.

- Fertilizer value: total content and plant available amounts of macro- and micronutrients in products, plants and soils.
- Soil quality: pH, EC, organic carbon, nitrate residue, nutrient leaching, sodium adsorption ratio, phosphorus and heavy metal accumulation.

CROP YIELD RESULTS 2013

- On both locations, no statistical differences were observed when comparing classic fertilization versus green fertilizers with respect to crop yield.





- In Wingene (sandy), scenario eight with complete substitution of artificial fertilizers by air scrubber water and LF digestate, showed a slightly higher yield as compared to the reference scenario.

- In Roeselare (sandy loam), scenarios with complete substition of artifical fertilizers have shown the tendency to have equal or slightly higher yield as compared to the reference.

- Compilation of the results from the three-year trial will contribute significantly in evaluating bio-digestion derivatives as a nutrient source.

- In March 2014, a new field assessment will be conducted. In this trial, a wider range of bio-digestion derivatives, such as evaporated effluent from biological treatment, will be tested on cauliflower.

CONTRIBUTION TO THE TRANSITION FROM FOSSIL TO BIO-BASED ECONOMY AS A CATALYST FOR RECOGNITION OF GREEN FERTILIZERS WITHIN THE EUROPEAN LEGISLATION

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